Space Weather Technical Forecast

Issued on Tuesday, 06 September 2022 at 01:24 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of further M-class flares (R1-R2 Blackouts). Chance of G1/G2 Minor/Moderate Geomagnetic Storms day 1 (6th). Active electron Fluence.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was Moderate with one M-class flare observed at 05/1805 UTC, originating from AR3089. There are now seven sunspot regions on the visible disc. The largest and most complex remains AR3089, which is currently traversing the southwestern limb. The remaining sunspots are all small and simple. There have been no Earth directed CMEs seen in satellite imagery over the last 24 hours, although there is a diminishing chance of a glancing blow early in the forecast from a CME launched on 2nd September, this CME is now over 12 hours late.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by ACE and DSCOVR at L1, was indicative of a waning HSS, thought to be from CH20/+. The wind speed declined from 660 km/s to between 530-590 km/s. Density was average or just above average. Total interplanetary magnetic field strength, Bt, was weak. The north-south component, Bz, was largely negative, varying between +7/-8 nT. The Phi angle was largely positive (away from the Sun). Geomagnetic activity varied between Active (Kp4) and G1/Minor storm (Kp5) intervals.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV), as measured at GEOS-16 was at background levels. The high energy electron flux (greater than 2 MeV) was mostly at Moderate to High levels, with a peak of 9250 pfu at 05/1640 UTC. The 24-hour integrated electron fluence has been on a rising trend, rising above the Active threshold (1e8 integrated pfu) by 05/1500 UTC. 2.06e8 integrated pfu was observed at 06/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be largely Low, with a chance of becoming Moderate with isolated M-class flares, mostly from AR3089. This spot will likely exert influence on the flare risk due to its location until the end of day 2 (7th). New regions are currently appearing on the east limb, though analysis is currently difficult due to foreshortening, these may have an influence on the flare risk if they appear to be complex regions.

Solar Wind / Geomagnetic Activity: There is a diminishing chance of a glancing blow early in the forecast from a CME launched on 2nd September, this CME is now over 12 hours late. No other Earth-directed CMEs expected. Solar winds will initially be elevated due to the HSS from CH20/+, gradually easing to slightly elevated by day 2 (7th). There is a risk of a HSS arriving from a faint coronal hole, currently near north centre disk late on day 1 or early day 2 (6th or 7th) perhaps enhancing winds speeds once again to elevated, though confidence on this is much lower than average. Wind speeds should then revert back to slightly elevated or background by day 3 or 4 (8th or 9th). Geomagnetic activity will likely be Unsettled to Active, with a chance of G1/Minor Storm intervals on day 1 (6th) and perhaps early on day 2 (7th). Baseline Geomagnetic activity should become Quiet to Unsettled by day 3 (7th) onward.

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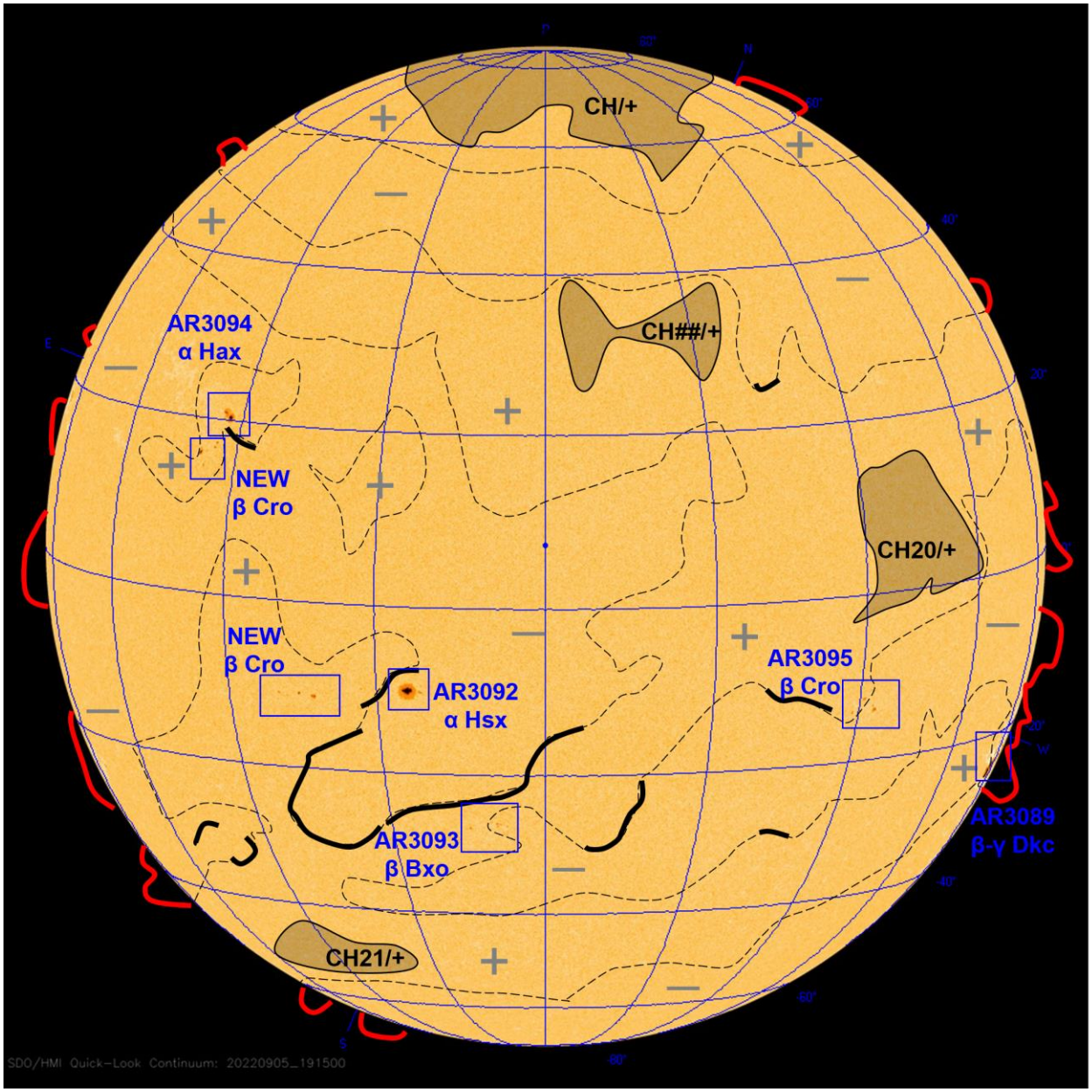
Energetic Particles / Solar Radiation: High energy protons (greater than 10 MeV) are expected to remain below S1/Minor radiation storm levels, with a very slight chance of an increase should any significant flares occur from AR3089 around the southwest limb until the end of day 2 (7th). The high energy (greater than 2 MeV) electron flux is expected to remain at high or moderate levels over the following days, with long periods over the 1000pfu threshold increasingly likely. The corresponding 24 hour fluence is expected remain above the Active threshold through the period, with a slight chance it may rise above the Very High threshold (1x10^9) on days 1 and 2 (6th and 7th).

Figure 1. Solar Analysis Valid 05/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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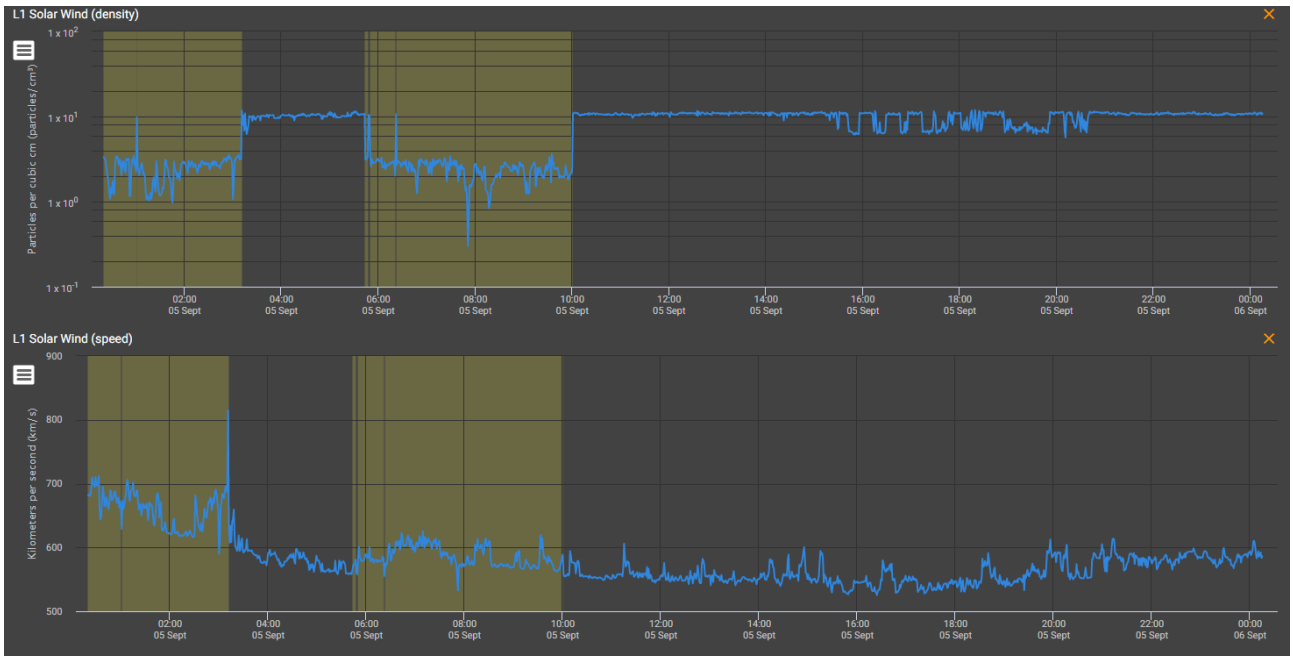
Geomagnetic Storms:

There is a diminishing chance of a glancing blow early in the forecast from a CME launched on 2nd September, this CME is now over 12 hours late and there are no clear indicators of a CME arrival in recent solar wind traces. This feature was expected to only have a minor impact at Earth, and now is even less likely to give a notable geomagnetic response. No other Earth-directed CMEs expected.

Solar winds will initially be elevated due to the HSS from CH20/+, gradually easing to slightly elevated by day 2 (7th). There is a risk of a HSS arriving from a faint coronal hole (evident on SDO 221 imagery but not really 193), currently near north centre disk late on 6th or early 7th, perhaps enhancing winds speeds once again to elevated, though confidence on this is much lower than average. Wind speeds should then revert back to slightly elevated or background by 8th or 9th. Geomagnetic activity will likely be Unsettled to Active, with a chance of G1/Minor Storm intervals on day 1 (6th) and perhaps early on day 2 (7th). Baseline Geomagnetic activity should become Quiet to Unsettled by day 3 (7th) onward.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	Yes	40	20	5	1
Strong	G3	No	2	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: Solar wind density and speed 24 hour trace.



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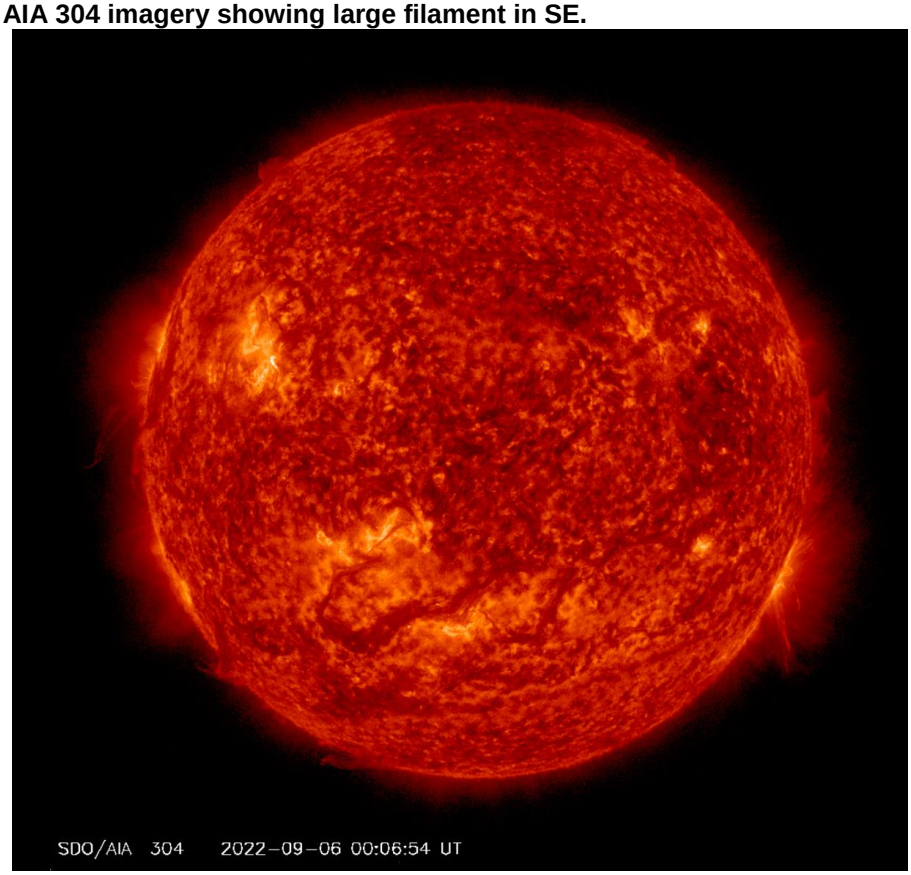
Radio Blackouts - X-Ray Flares:

There are currently nine sunspots on the visible disk. Solar activity is expected to be largely Low, with a chance of becoming Moderate with isolated M-class flares, mostly from AR3089. This spot will likely exert influence on the flare risk due to its location until the end of day 2 (7th), when it will have rotate completely off the visible disk and past 110 degrees west. New regions are currently appearing on the east limb, though analysis is currently difficult due to foreshortening, these may have an influence on the flare risk if they appear to be complex regions, though they currently seem to be smaller and simpler than expected.

A large filament continues to be visible in the southeast quadrant and will need to be monitored for any lift-off, particularly when it approaches the central meridian. This filament has shown little change over the past few days and appears to be a rather stable feature at present.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	40	40	20	20
Very Active	R3 to R5 X Class	No	5	5	2	2

Figure 3: SDO AIA 304 imagery showing large filament in SE.



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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10MeV) remains at background values. Despite its apparent stability, AR3089 (Dkc/Beta-Gamma) continues to present a very slight chance of a proton event at Earth, should there be any significant flaring. This risk will continue until the end of day 2 (7th) whilst the region rotates well beyond the west limb.

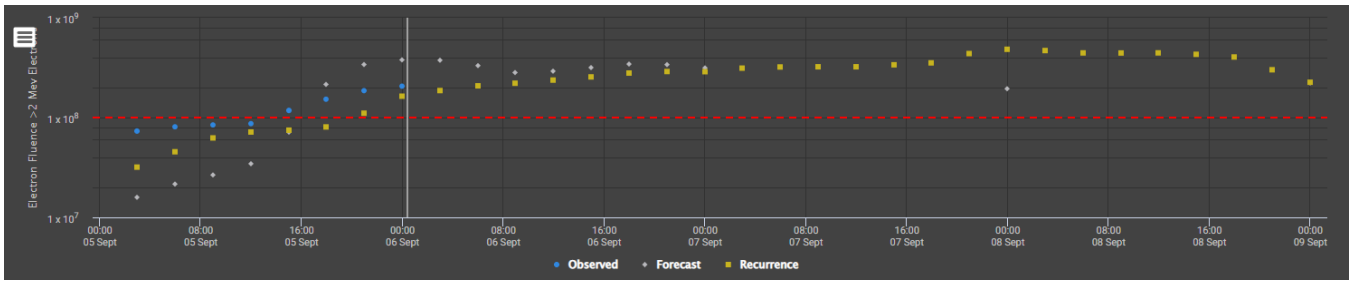
Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	1	1
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

The high energy (greater than 2 MeV) electron flux has risen from moderate to high, due to the recent enhancements from the HSS of CH19/+ and CH20/+, recharging the Van Allen belts in electron populations. Electron flux is expected to remain at high levels over the following days. The corresponding 24 hour fluence is expected remain above the Active threshold through the period, with a slight chance it may rise above the Very High threshold (1x10^9 pfu) mainly on days 1 and 2 (6th and 7th).

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	100	80	70	70
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	10	15	5	5

Figure 4: REFM Integrated flux/fluence observations, persistence and forecast.



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